

C L A I M S

1. A plasma processing device characterized by
2 comprising:
3 a table for placing a target object thereon;
4 a processing vessel for accommodating said
5 table; and
6 a slot antenna arranged to oppose said table
7 to supply an electromagnetic field into said processing
8 vessel, wherein
9 radiation coefficients of a plurality of slots
10 formed in an antenna surface of said slot antenna
11 increase monotonously in a radial direction of the
12 antenna surface from a central portion of the antenna
13 surface until a first intermediate portion on the way to
14 a peripheral portion, and maintain values obtained at
15 the first intermediate portion from the first
16 intermediate portion toward the peripheral portion.

2. A plasma processing device according to claim
2 1, characterized in that lengths of the slots change
3 monotonously from the central portion until the first
4 intermediate portion of the antenna surface, and
5 maintain lengths obtained at the first intermediate
6 portion from the first intermediate portion toward the
7 peripheral portion.

3. A plasma processing device according to claim
2, characterized in that when lengths L of the slots
satisfy:

$$L \leq \lambda_g/2$$

or

$(N/2 + 1/4) \times \lambda_g \leq L \leq (N + 1) \times \lambda_g/2$ (N is a
natural number) where λ_g is a wavelength of an
electromagnetic field in said slot antenna, the lengths
of the slots increase monotonously from the central
portion until the first intermediate portion.

4. A plasma processing device according to claim
2, characterized in that when lengths L of the slots
satisfy:

$$L \leq \lambda_g/2$$

or

$(N/2 + 1/4) \times \lambda_g \leq L \leq (N + 1) \times \lambda_g/2$ (N is a
natural number) where λ_g is a wavelength of an
electromagnetic field in said slot antenna, from an
innermost slot of the antenna surface until an arbitrary
slot of the antenna surface in the radial direction, a
length of each slot is larger than that of a slot inside
each slot, and from the arbitrary slot toward an
outermost slot of the antenna surface, the length of
each slot is equal to that of the arbitrary slot.

5. A plasma processing device according to claim

2 2, characterized in that when the lengths L of the slots
3 satisfy:

4
$$N \times \lambda_g/2 \leq L \leq (N/2 + 1/4) \times \lambda_g$$
 (N is a natural
5 number) where λ_g is a wavelength of an electromagnetic
6 field in said slot antenna, the lengths of the slots
7 decrease monotonously from the central portion until the
8 first intermediate portion.

6. A plasma processing device according to claim
2 2, characterized in that when lengths L of the slots
3 satisfy:

4
$$N \times \lambda_g/2 \leq L \leq (N/2 + 1/4) \times \lambda_g$$
 (N is a natural
5 number) where λ_g is a wavelength of an electromagnetic
6 field in said slot antenna, from an innermost slot of
7 the antenna surface until an arbitrary slot of the
8 antenna surface in the radial direction, a length of
9 each slot is smaller than that of a slot inside each
10 slot, and from the arbitrary slot toward an outermost
11 slot of the antenna surface, the length of each slot is
12 equal to that of the arbitrary slot.

7. A plasma processing device according to claim
2 1, characterized in that, in the radial direction of the
3 antenna surface, the radiation coefficients of the slots
4 maintain values obtained at the first intermediate
5 portion from the first intermediate portion of the
6 antenna surface until the second intermediate portion on

7 the way to the peripheral portion, and decrease
8 monotonously from the second intermediate portion until
9 the peripheral portion.

8. A plasma processing device according to claim
2 7, characterized in that lengths of the slots change
3 monotonously from the central portion until the first
4 intermediate portion of the antenna surface, maintain
5 lengths obtained at the first intermediate portion from
6 the first intermediate portion until the second
7 intermediate portion, and change monotonously from the
8 second intermediate portion until the peripheral portion,
9 inversely to the slots from the central portion until
10 the first intermediate portion.

9. A plasma processing device according to claim
2 8, characterized in that when lengths L of the slots
3 satisfy:

4
$$L \leq \lambda_g/2$$

5 or

6
$$(N/2 + 1/4) \times \lambda_g \leq L \leq (N + 1) \times \lambda_g/2$$
 (N is a
7 natural number) where λ_g is a wavelength of an
8 electromagnetic field in said slot antenna, the lengths
9 of the slots decrease monotonously from the second
10 intermediate portion until the peripheral portion.

10. A plasma processing device according to claim

2 8, characterized in that when the lengths L of the slots
3 satisfy:

$$4 \quad L \leq \lambda g/2$$

5 or

6 $(N/2 + 1/4) \times \lambda g \leq L \leq (N + 1) \times \lambda g/2$ (N is a
7 natural number) where λg is a wavelength of an
8 electromagnetic field in said slot antenna, from an
9 innermost slot of the antenna surface until a slot at
10 the first intermediate portion of the antenna surface in
11 the radial direction, a length of each slot is larger
12 than that of a slot inside each slot, from the slot at
13 the first intermediate portion until a slot at the
14 second intermediate portion in the radial direction, the
15 length of each slot is equal to that of the slot at the
16 first intermediate portion, and from the slot at the
17 second intermediate portion until an outermost slot in
18 the radial direction, the length of each slot is smaller
19 than that of a slot inside each slot.

11. A plasma processing device according to claim
2 8, characterized in that when lengths L of the slots
3 satisfy:

4 $N \times \lambda g/2 \leq L \leq (N/2 + 1/4) \times \lambda g$ (N is a natural
5 number) where λg is a wavelength of an electromagnetic
6 field in said slot antenna, the lengths of the slots
7 increase monotonously from the second intermediate
8 portion until the peripheral portion.

12. A plasma processing device according to claim
2 8, characterized in that when lengths L of the slots
3 satisfy:
4
$$N \times \lambda_g/2 \leq L \leq (N/2 + 1/4) \times \lambda_g$$
 (N is a natural
5 number) where λ_g is a wavelength of an electromagnetic
6 field in said slot antenna, from an innermost slot of
7 the antenna surface until a slot at the first
8 intermediate portion of the antenna surface in the
9 radial direction, a length of each slot is smaller than
10 that of a slot inside each slot, from the slot at the
11 first intermediate portion until a slot at the second
12 intermediate portion in the radial direction, the length
13 of each slot is equal to that of the slot at the first
14 intermediate portion, and from the slot at the second
15 intermediate portion until an outermost slot in the
16 radial direction, the length of each slot is larger than
17 that of a slot inside each slot.

13. A plasma generating method characterized in
2 that when an electromagnetic field is supplied into a
3 processing vessel by using a slot antenna in which a
4 plurality of slots are formed in an antenna surface
5 thereof, to generate a plasma, radiation coefficients of
6 the slots are increased monotonously from a central
7 portion of the antenna surface until the first
8 intermediate portion on the way to a peripheral portion,

9 and values of the radiation coefficients obtained at the
10 first intermediate portion are maintained from the first
11 intermediate portion toward the peripheral portion.

14. A plasma generating method according to claim
2 13, characterized in that the values of the radiation
3 coefficients obtained at the first intermediate portion
4 are maintained from the first intermediate portion of
5 the antenna surface until a second intermediate portion
6 on the way to the peripheral portion in the radial
7 direction of the antenna surface, and the radiation
8 coefficients are decreased monotonously from the second
9 intermediate portion until the peripheral portion.